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JANUARY 1989

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EVT 30-88

ROAD TESTING OF NAVY MINES

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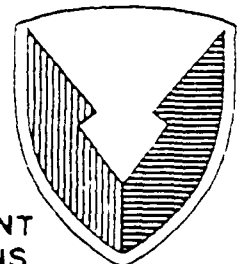
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Naval Weapons Station, Earle

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US ARMY DEFENSE AMMUNITION  
CENTER AND SCHOOL

EVALUATION DIVISION  
SAVANNA, ILLINOIS 61074-9639

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# REPORT DOCUMENTATION PAGE

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<p>The U.S. Army Defense Ammunition Center and School (USADACS) was requested by the Naval Weapons Station Earle to conduct a road transportability test with a series of Navy Alpha mines. The purpose of the tests was to confirm if the Alpha mine drawings are adequate for CONUS highway shipments.</p> <p>Two separate distinct Navy truckload drawings depicting the procedures to be tested along with the inert items to be tested were received at USADACS prior to the scheduled test. The first test load consisted of MK 62, MK 63, and MK 64 Alpha mines on a commercial flatbed trailer. The second test load consisted of MK 56 and MK 55 Alpha mines on a commercial flatbed trailer.</p> <p>Both test loads completed the USADACS five step road hazard course. With the exception of the MK 64 mines, all other tested securement</p>					
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#19 Abstract

procedures for the MK 62, MK 63, MK 55, and MK 56 mines were acceptable for movement over public highway. A retest of MK 64 mines also failed.

Navy test attendees agreed to no further testing of the MK 64 mines at this time.

U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL  
 Evaluation Division  
 Savanna, IL 61074-9639

REPORT NO. FVT 30-88

ROAD TESTING OF THE NAVY MINES

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## PART 1

### GENERAL

#### A. INTRODUCTION

The U.S. Army Defense Ammunition Center and School (USADACS) was requested by Naval Weapons Station Earle to conduct a road transportability test with a series of Navy Alpha Mines.

The first of two test loads consisted of MK 62, MK 63, and MK 64 Alpha mines blocked, braced, and chained to a 40-foot commercial flatbed trailer. The second test load consisted of MK 56 and MK 55 Alpha Mines blocked, braced, and chained to a 40-foot commercial flatbed trailer. Both test loads were subjected to the USADACS five-step road hazard course.

#### B. AUTHORITY

Testing has been accomplished in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.

#### C. OBJECTIVE

The objective of the tests was to determine the adequacy of the restraint procedures to withstand the forces generated over the USADACS road hazard course.

#### D. CONCLUSIONS

1. The MK 62, MK 63, MK 55 and MK 56 Alpha mines restraint methods were successfully tested and are considered to be acceptable for movement of the mines on commercial flatbed trailers over public highways.

2. The MK 64 Alpha mine tiedown procedure failed the road hazard course test and retest. An approved restraint method was not developed.

E. RECOMMENDATIONS

1. The MK 64 Alpha mine restraint system failed during the initial test and the retest. Recommend additional testing for the development of an approved method of securement.

2. Recommend the center pallet of the three MK 55 mine pallets be moved 5-1/2-inches rearward to permit the strapping or protector board to bear down on the center pallet as well as the outside pallets.

## PART 2

ATTENDEES

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### PART 3

#### ROAD TEST PROCEDURES

Five separate road testing steps are required as identified herein:

1. Step No. 1. This step provides for the specimen load to be driven over a 200-foot-long segment of concrete paved road which consists of two series of railroad ties projecting 6 inches above the level of the road surface. This hazard course was traversed two times and repeated per Step No. 4.

a. The first series of ties is spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

b. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.

c. The second series of ties is alternately positioned similarly to the first, but spaced on 10-foot centers for a distance of 50 feet.

d. The specimen load was driven across the hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

2. Step No. 2. This step consists of 30 miles of travel over available rough roads consisting of gravel, concrete and asphalt, curves, cattle gates, and stops and starts.

3. Step No. 3. This step provides for the specimen load to be subjected to three full air brake stops while traveling in the forward direction, and one in the reverse direction down a 7 percent grade. The first three stops are at speeds of 5, 10, and 15 mph while the stop in the reverse direction is of approximately 5 mph.

4. Step No. 4. This step consists of a repeat of that identified in Step No. 1 above.

5. Step No. 5. This step provides for the specimen load to be driven over a 300-foot-long segment of concrete paved road which has rails spaced on 26-1/2-inch centers and protruding 2 inches above the road surface. The specimen load was driven at the speed which will produce the most violent response.

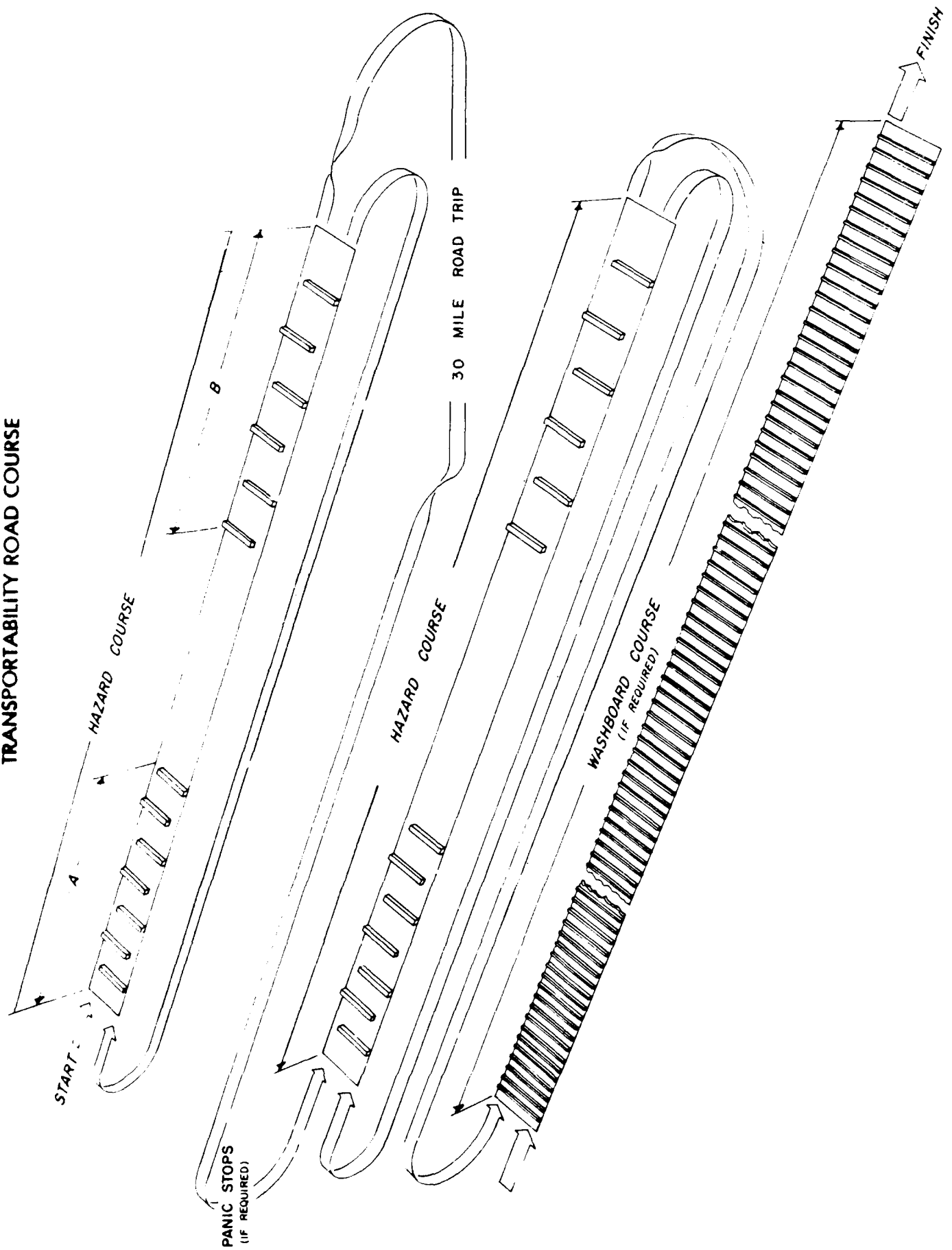
NOTE: Step Nos. 3 and 5 may be deleted at the discretion of the test conductor.

#### INSPECTIONS AND DATA COLLECTION

At selected intervals during testing, thorough inspections of the specimen loads were made by technically proficient personnel to collect data on the specimen load and equipment resulting from above load test steps. This data is recorded in Part 5 following.

# US ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

## TRANSPORTABILITY ROAD COURSE



PART 4

TEST SPECIMENS, LOAD DRAWINGS AND RESULTS

## TEST SPECIMEN AND RESULTS

### A. PRETEST ASSEMBLY

Test No. 1 was a test load prepared in accordance with the Department of Navy, Naval Weapons Handling Center Drawing No. NWHC 10823. From front to rear, the load consisted of MK 64, MK 63, and MK 62 Navy Alpha configured mines on a 40-foot-long commercial flatbed semitrailer, TRI-STATE Trailer No. 340310.

The two MK 64 Alpha mine pallets were repalletized in an effort to position the mines so as to prevent the fins from adjacent mines from making contact. To prevent each MK 64 mine from rotating, two internal 1-1/4-inch steel bands were used to encircle the mine. The bands extended over the mine, around the outside longitudinal member of the pallet bottom frame, around the inside longitudinal member of the pallet bottom frame, around the inside longitudinal member of the pallet top frame and connected to the band end over the mine.

The two MK 63 Alpha Mine Pallets were repalletized with two MK 63 mines in each pallet. During repalletizing, wooden spacers were added between the top and bottom pallet frame and the nose of the MK 63 mines. Also, wooden blocks were positioned between the MK 63 lifting lugs and a lateral member of the top pallet frame.

The two MK 62 Alpha Mine Pallets were also repalletized with two MK 62 mines in each pallet. During repalletization, wooden spacers were added between the top and bottom pallet frame and the nose of the MK 62 mines. Wooden blocks were positioned between the MK 62 lifting lugs and a lateral member of the top pallet frame.

All three mine types required nailed wooden prepositioned blocking. The MK 64 and MK 62 were narrow enough to permit the nailing of side blocking. Two steel chains with load binders were used over each pair of mine pallets.

#### B. TEST I ANALYSIS

Under the nose of the MK 62 and MK 63 Alpha mines, the pallet bases deflected downward during the completion of the USADACS road hazard course. The pallet deflection resulted from the placement of the wooden spacer between the mine nose end and the extreme unsupported steel pallet section. Position of the wooden spacer at the location tested placed all the load on the point farthest from a support.

Loading the support closer to the pallet skid with a smaller wooden spacer would most likely prevent a recurrence of the pallet deflection. This relocation of the spacer would also be much closer to the banding strap creating a much tighter pallet.

As the USADACS road hazard course progressed, the MK 64 mines continued to move rearward within the confines of their steel pallet. The rearward movement was enhanced by the nose end of the pallet top moving down the tapered nose of the mine. This pallet top movement caused a loosening of the bundling straps and chains which permitted the MK 64 mines to rotate on the pallet. Due to closeness of the tail fins, the mine rotation resulted in adjacent mine fins making contact and causing fin damage. Fin damage is critical to flight stability and free fall drag.

The MK 64 mines were not left in a transportable condition following completion of the 5-step road hazard course. This failure necessitates a retest with the MK 64 mines.

# NOTES.

- THIS DRAWING PROVIDES DETAILED INSTRUCTIONS FOR THE TRUCKLOADING OF PK 36, PK 40 AND PK 41 ALPHA CONFIGURED MINES FOR A ONE TIME TEST AND TRIAL SHIPMENT AT NAVAL RESEARCH LABORATORY, DALLAS, TEXAS.
- THE PROCEDURES DESCRIBED HEREIN ARE INTENDED FOR A 40 FT FLATBED TRAILER.
- ALL MATERIALS AND PROCEDURES SHALL BE AS SPECIFIED IN THE GENERAL TRUCKLOADING DOCUMENT, MIL STD 1320.
- DO NOT OVERTENSION TENSION CHAINS OR USE "CHAINS" ON LOAD BUNDLES. LOAD BUNDLES SHOULD BE HANDLED WITH ONLY ONE END OF THE CHAIN.
- NAIL CROSSMEMBERS TO TRAILER FLOOR WITH 1 - 16d NAIL EVERY 6 - 8 INCHES. NAIL 2ND PIECE TO 1ST IN LINE MANNER.
- NAIL CLEATS TO TRAILER FLOOR WITH 5 - 16d NAILS. NAIL 2ND PIECE TO 1ST IN LINE MANNER.
- NAIL MIDDLE BLOCK TO CROSSMEMBER WITH 5 - 16d NAILS.
- NAIL SLEEPERS TO TRAILER FLOOR WITH 6 - 16d NAILS. NAIL 2ND PIECE TO 1ST IN LINE MANNER.

40 FT X 56 INCH TRAILER  
(DO NOT USE TRAILER WITH  
NON WATERTIGHT FLOORS.)

PK 40 INSTRUCTION  
SEE MARC 8188

PK 41 INSTRUCTION  
SEE MARC 8189

PK 36 INSTRUCTIONS

- 1 - 2 X 6 DOUBLED  
SEE NOTE 5
- 2 - 2 X 6 DOUBLED  
SEE NOTE 5
- 3 - 2 X 6 DOUBLED  
SEE NOTE 5
- 4 - 2 X 6 DOUBLED  
SEE NOTE 5
- 5 - 2 X 6 DOUBLED  
SEE NOTE 5
- 6 - 2 X 6 DOUBLED  
SEE NOTE 5
- 7 - 2 X 6 DOUBLED  
SEE NOTE 5
- 8 - 2 X 6 DOUBLED  
SEE NOTE 5
- 9 - 2 X 4 DOUBLED  
SEE NOTE 8
- 10 - PROTECTOR BOARDS. 2 X 6 DOUBLED. LAMINATE NAIL TOGETHER WITH 5 - 10d NAILS.
- 11 - SECURE CHAIN AND LOAD BINDER TO PROTECTOR BOARD WITH 5 - 10d NAILS, CLENCHED OVER THE TOP RAILS.
- 12 - 2 X 4 DOUBLED  
SEE NOTE 8
- 13 - 2 X 4 DOUBLED  
SEE NOTE 8

2 X 6 DOUBLED  
SEE NOTE 5

2 X 6 DOUBLED  
SEE NOTE 6

2 X 4  
SEE NOTE 7

2 X 6 DOUBLED  
SEE NOTE 6

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SEE NOTE 5

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SEE NOTE 6

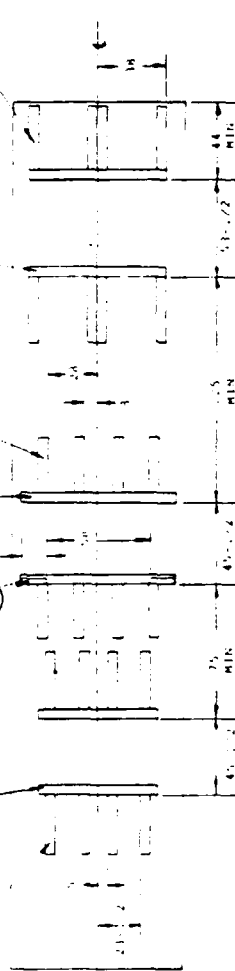
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SEE NOTE 6

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2 X 6 DOUBLED  
SEE NOTE 6



TRAILER FRONT

DETAIL F  
PIN POSITIONED LOCKING

## LIST OF MATERIALS

REQ'D	ITEM	DESCRIPTION	MAT'L/DWG DIMENSIONS
4	13	PROTECTOR, AFT	WOOD
4	12	PROTECTOR, FRONT	WOOD
6	11	CHAIN & LOAD BINDER	STEEL
4	10	PROTECTOR BOARD	WOOD
4	9	AFT SLEEPER	WOOD
2	8	MIDDLE BLOCK	WOOD
4	7	FRONT SLEEPER	WOOD
16	6	AFT CLEAT	WOOD
16	5	MIDDLE CLEAT	WOOD
16	4	FRONT CLEAT	WOOD
4	3	AFT CROSSMEMBER	WOOD
4	2	MIDDLE CROSSMEMBER	WOOD
4	1	FRONT CROSSMEMBER	WOOD

### CLASSIFICATION OF CHARACTERISTICS

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2	1	1	2	1	1
3	1	1			



ROAD TEST DATA

TEST NO. 1

DATE: 24-25 January 1989

TEST SPECIMEN: MK 62, MK 63 and MK 64 Alpha Mines blocked with prepositioned dunnage and secured with chains with load binders on a 40-foot commercial flatbed trailer.

PASS 1-A OVER FIRST SERIES OF TIES: 6.30 SEC 5.41 mph

PASS 1-B OVER SECOND SERIES OF TIES: 6.30 SEC 5.41 mph

REMARKS: The MK 64 mines moved slightly rearward within their pallets.

PASS 2-A OVER FIRST SERIES OF TIES: 6.45 SEC 5.28 mph

PASS 2-B OVER SECOND SERIES OF TIES: 6:30 SEC 5.41 mph

REMARKS: MK 64 mines moved 3/16-inch rearward within their pallets.

30 MILE ROAD TEST: Notice pallet section under nose of MK 64 mines bend downward 1/2-inch.

PANIC STOP TEST: No movement

PASS 3-A OVER FIRST SERIES OF TIES: 6.30 SEC 5.41 mph

PASS 3-B OVER SECOND SERIES OF TIES: 6.45 SEC 5.28 mph

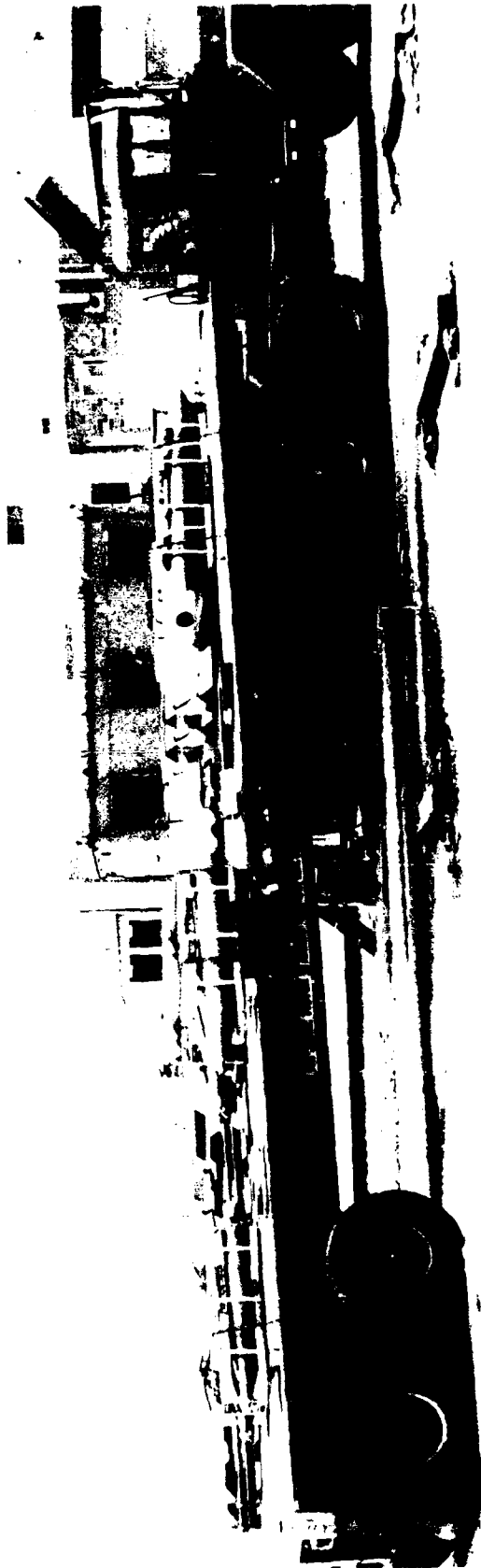
REMARKS: No movement

PASS 4-A OVER FIRST SERIES OF TIES: 6.15 SEC 5.54 mph

PASS 4-B OVER SECOND SERIES OF TIES: 6.30 SEC 5.41 mph

REMARKS: MK 64 mines moved 1/4-inch rearward within their pallets. MK 63 mines pallets moved left 1/2-inch.

WASHBOARD COURSE: MK 64 mines moved rearward from 1-7/8-inch to 3-3/8-inch causing loose chains and banding resulting in FAILURE. Both MK 63 and MK 62 experienced 1/2-inch and 1/4-inch downward bending of the nose and rear pallet ends, respectively.



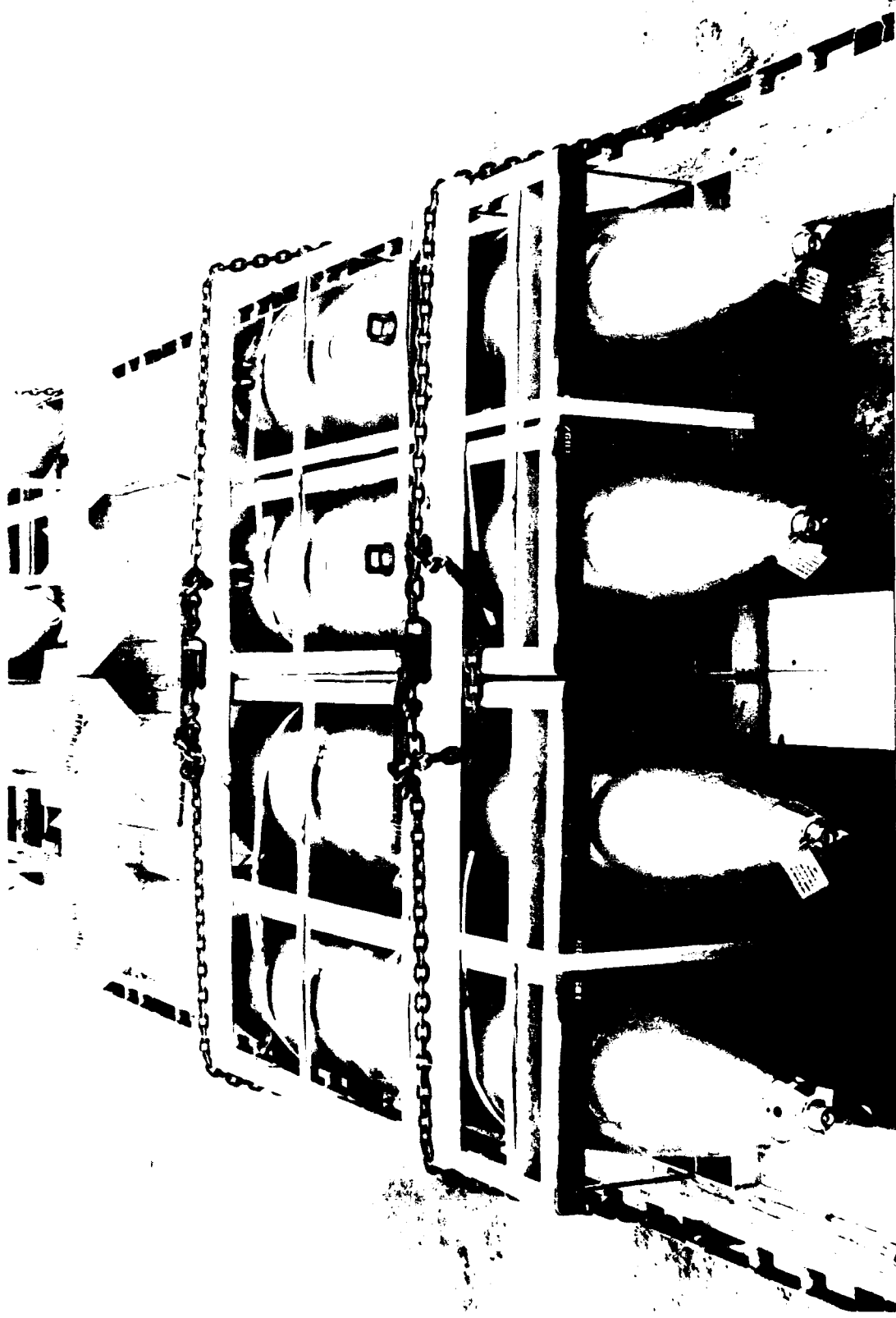
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Photo No. 1 View of the MK 62, MK 63 and MK 64 Alpha mines secured to a 40-foot-long commercial flatbed semitrailer.



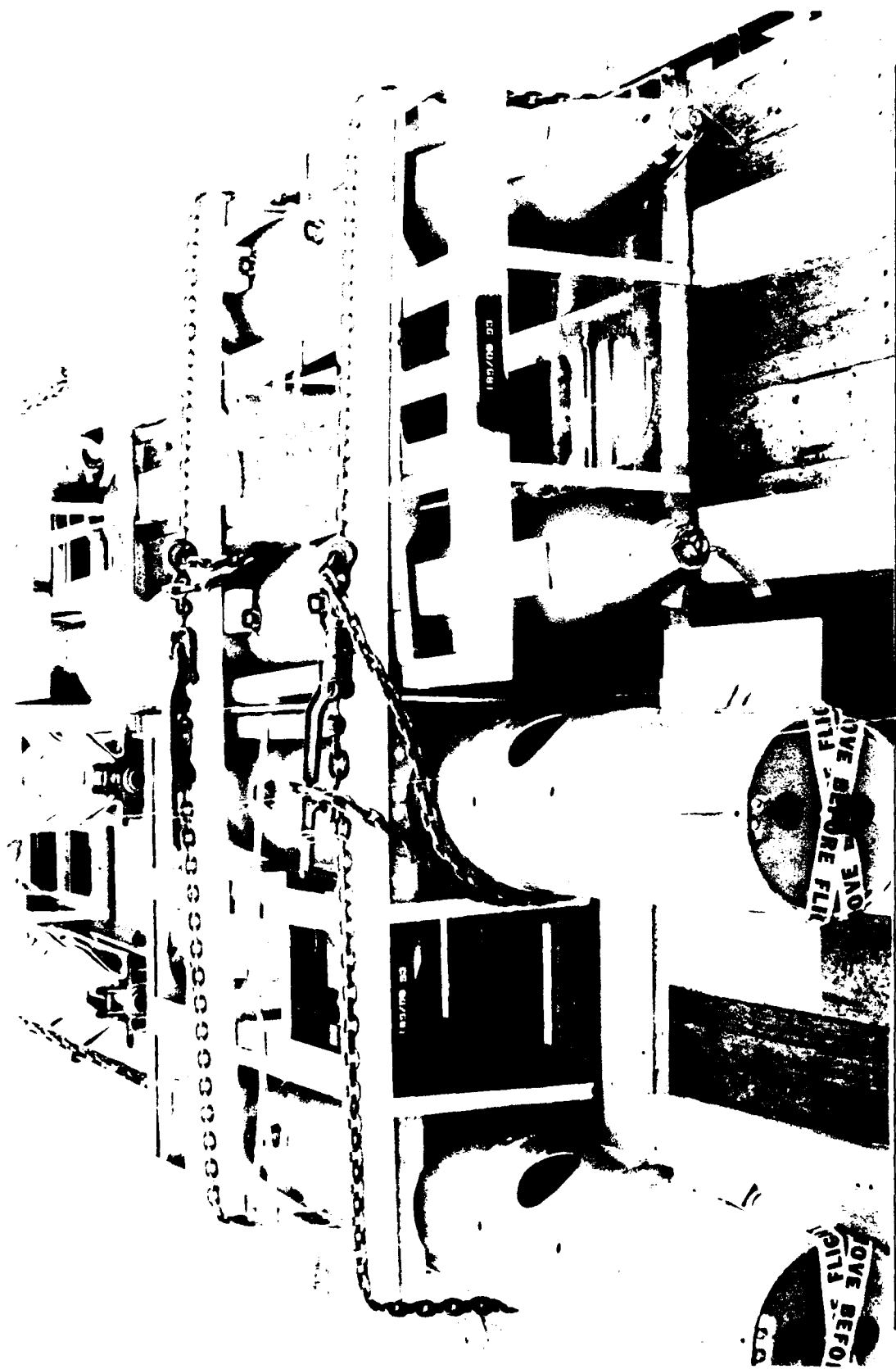
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Photo No. 2 View of the prepositioned nailed wooden dunnage on the 40-foot-long commercial flatbed semitrailer.



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12. A view of the MK 60 pallets being loaded on the MK 60 palletizing machine. The MK 60 palletizing machine is a large, industrial structure with multiple levels and a complex system of chains and rollers. The pallets are visible on the machine, and the background shows a building with a sign that reads "DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL".



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Photo No. 4 View of the MK 63 pallets prior to testing on the 40-foot commercial flatbed semitrailer. Note wooden blocks between pallets and steel pallets. Also note plywood sheet between two pallets.



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Photo No. 5 View of the MK 62 pallets prior to loading on the flatbed semitrailer. Note the wooden blocks being loaded onto the MK 62 pallets.



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Photo No. 6 View of a MK 63 mine in the pallet showing the movement of the wooden blocking during testing.



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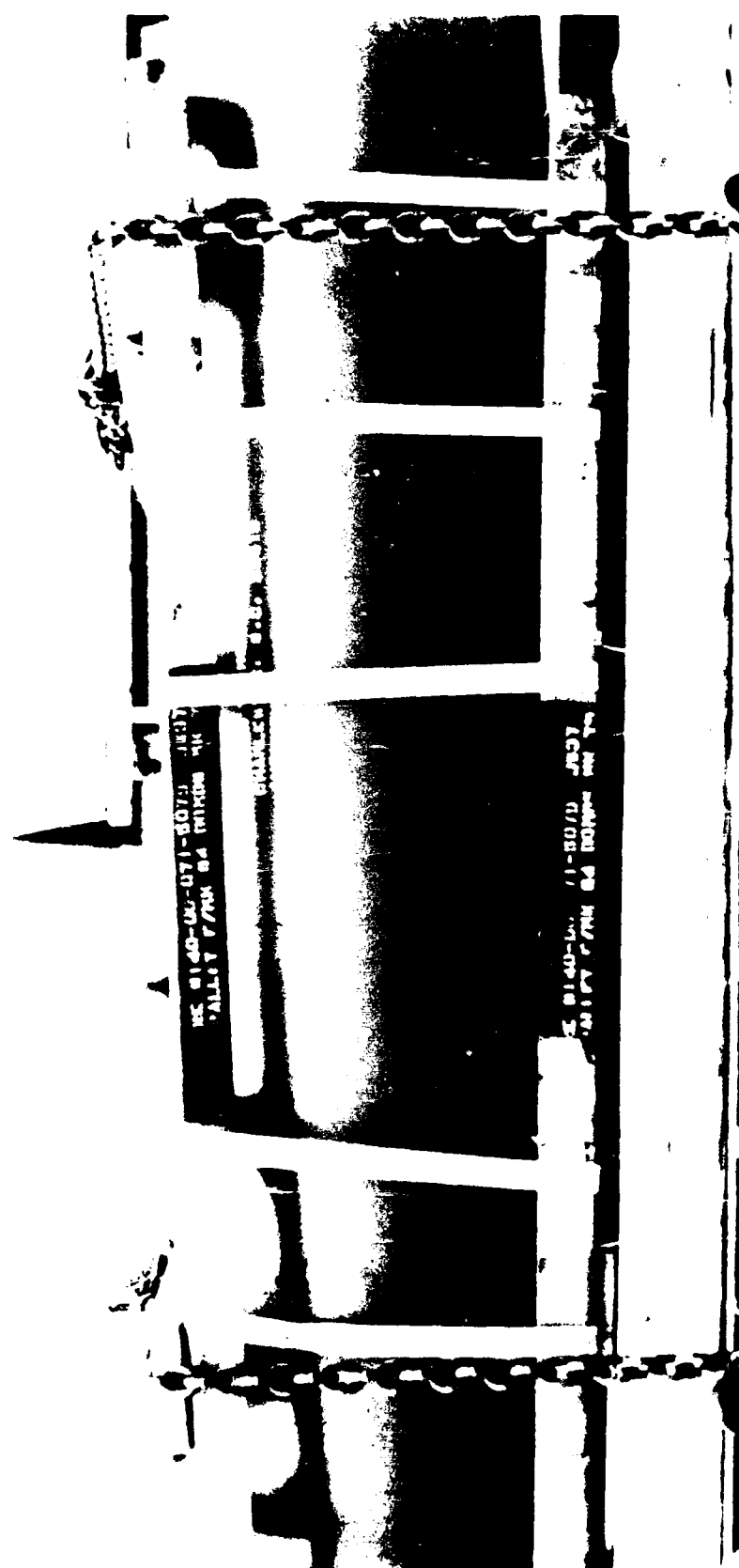
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Photo No. - View of MK 64 mine nose and showing looseness of pallet banding and where tapered end of mine has moved away from fortified area of steel pallet.



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There is a large, dark, rectangular object, possibly a piece of equipment or a container, with a lighter, triangular shape attached to its side. The image is heavily shadowed and appears to be a photocopy of a document.
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### C. TEST NO. 2 ANALYSIS

Test No. 2 was a test load prepared in accordance with the Department of Navy, Naval Weapons Handling Center Drawing No. NWAC 10823. From front to rear, the load consisted of MK 55 and MK 56 Navy Alpha configured mines on a 40-foot-long commercial flatbed semitrailer, TRI-STATE Trailer No. 340310

A previously damaged nose cone shield separated from one of the MK 55 mines during the first step of the road hazard course. The MK 55 mine fins made contact with the floor of the semitrailer but no damage resulted. The nose of the MK 56 mines made contact with the prepositioned wooden dunnage; however, there was no evidence of damage. Due to reversing the direction of the MK 56 center pallet, the strapping or protector board did not bear on the mine frame. This lack of vertical restraint on the mine frame permitted the center of three MK 56 pallets to move up and down violently during the washboard step of the road hazard course. This condition can be corrected by moving the center MK 56 mine pallet forward 5-1/2 inches in relation to the center MK 56 mine pallet. This movement will align crossmembers of the top frame and allow the strapping or protector board to bear on all three pallets.

Both securement methods for MK 56 and MK 55 mines were acceptable for movement on/off public highway.



ROAD TEST DATA

TEST NO. 2

DATE: 26 January 1989

TEST SPECIMEN: MK 56 and MK 55 Alpha mines blocked with prepositioned dunnage and secured with chains with load binders on a 40-foot-long commercial flatbed trailer.

PASS 1-A OVER FIRST SERIES OF TIES: 6.45 SEC 5.28 mph

PASS 1-B OVER SECOND SERIES OF TIES: 6.30 SEC 5.41 mph

REMARKS: Left nose cone shield came off left MK 55 mine. MK 55 mine fins striking trailer's wooden floor. MK 56 noses striking dunnage.

PASS 2-A OVER FIRST SERIES OF TIES: 6.15 SEC 5.54 mph

PASS 2-B OVER SECOND SERIES OF TIES: 6.45 SEC 5.28 mph

REMARKS: MK 55 mines moved right 1/2-inch.

30 MILE ROAD TEST: No movement

PANIC STOP TEST: No movement

PASS 3-A OVER FIRST SERIES OF TIES: 6.45 SEC 5.28 mph

PASS 3-B OVER SECOND SERIES OF TIES: 6.15 SEC 5.54 mph

REMARKS: Nose end of MK 55 mines moving side-to-side approximately 2-inches. Nose strapping board moved rearward 3-1/2 inches. Front chain loose.

PASS 4-A OVER FIRST SERIES OF TIES: 6.75 SEC 5.05 mph

PASS 4-B OVER SECOND SERIES OF TIES: 6.90 SEC 4.94 mph

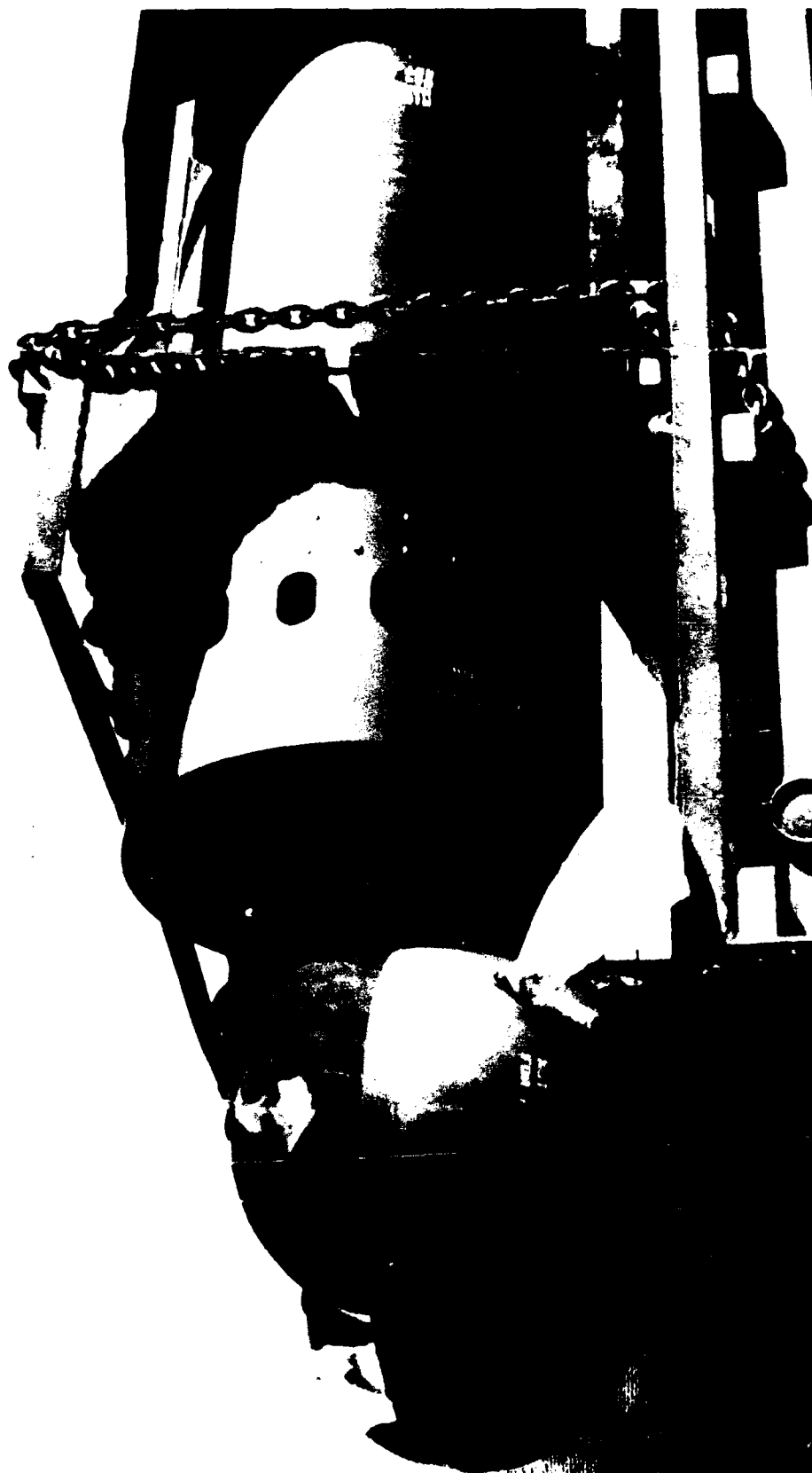
REMARKS: Nose strapping board moved rearward 1 inch.

WASHBOARD COURSE: Middle of three MK 56 mine pallet moved up and down violently.



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Photo No. 11 View of the MK 55 and MK 56 Alpha mines secured to a 40-foot-long commercial flatbed semitrailer.



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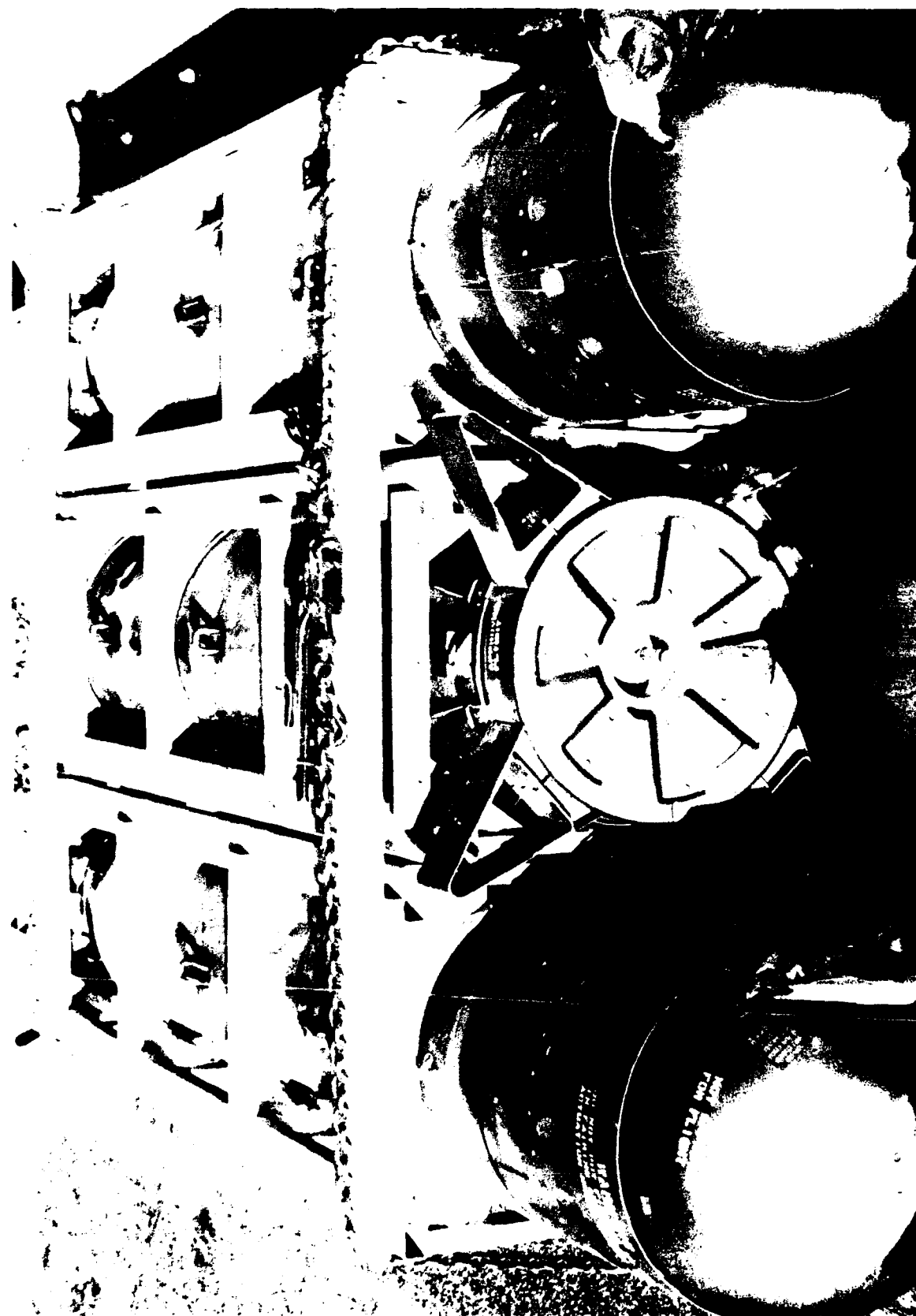
Photo No. 12 View of the MK 55 Alpha mine after being removed from its container.  
First pair of road hazard warning.





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Photo No. 13 View of the M2 55 Alpha mine flat that was transported to the base of the flatbed semitrailer. No image captured.



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D. TEST NO. 3 ANALYSIS

Test No. 3 is a retest of the MK 64 Alpha mine load. Prior to the test, the MK 64 mines were repalletized and rebanded omitting the internal banding. Wooden spacer blocks were placed between the lifting plugs and the pallet frame.

Since the first test failed during the washboard course, this retest began with a pass over the washboard course to measure the effectiveness of the load changes. The MK 64 mine load again failed over the washboard course and the test results were similar to the first test. No further testing of the MK 64 mines was performed.